Panasonic

Amorphous Silicon Solar Cells
Amorphous Photosensors

General Catalog of Specifications for Lighting Levels Indoors and Outdoors

CONTENT

Amorphous Silicon Solar Cells

Solar cells are classified by their material: crystal silicon, amorphous silicon, or compound semiconductor solar cells. Amorphous refers to objects without a definite shape and is defined as a non-crystal material. Unlike crystal silicon (Fig. 2) in which atomic arrangements are regular, amorphous silicon features irregular atomic arrangements (Fig. 1).

As a result, the reciprocal action between photons and silicon atoms occurs more frequently in amorphous silicon than in crystal silicon, allowing more light to be absorbed. Thus, an ultrathin amorphous silicon film less than 1 μm (1/1000 of 1 mm) can be produced and used for power generation. Our company is a world leader in developing "Amorton", which is an integrated (series connection structure) amorphous silicon solar cell. Amorton is fabricated by decomposing material gases and forming films on such substrates as glass.

For example, transparent electrode is first formed using a glass substrate. Then three amorphous silicon layers are formed in consecutive layers on the electrode-laden glass substrate: p-type amorphous, i-type amorphous, and n-type amorphous silicon layers. After that, a metal film electrode is created on the n-layer. Finally, it is covered in a protective film, and the solar cell's manufacturing is complete.

In this process, many solar cells are separated on the substrate, creating a series connection. This allows any desired voltage to be obtained. Flexible, thin, and durable solar cells can also be produced by utilizing metal or plastic as the substrate.

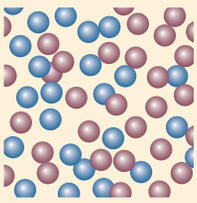


Fig.1 Amorphous silicon

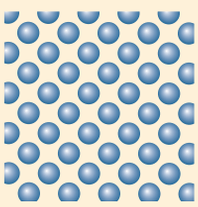


Fig.2 Crystal silicon

What is "Amorton"?

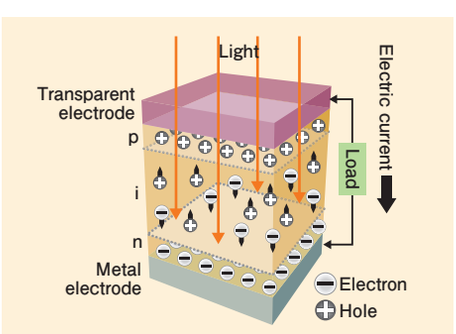
"Amorton" is the product name of Panasonic's Amorphous Silicon Solar Cells, which was named by integrating amorphous silicon and photons (particles of light).

History

1975 : Research begins on amorphous silicon solar cells
1978 : Integrated (series connection structure) amorphous silicon solar cells are developed
1980 : "Amorton", world's first amorphous silicon solar cells for comercial use, became a product

Principles of Power Generation

Power is generated in solar cells due to the photovoltaic effect of semiconductors.



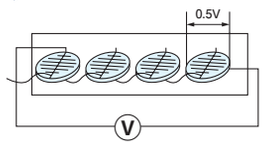
- When a semiconductor is exposed to a light source of suitable intensity, a large number of electrons (−) and holes (+) are generated and form electricity.
- At a p/n junction between two different semiconductor materials, the electrons are collected in the n-type material and the holes are collected in the p-type material by internal electric field.
- When an external load is connected, electricity flows through the load. Then generated electricity can be used.

Features

Copes easily with device's required drive voltage

Since multiple cells can be simultaneously connected in a series when the solar cells are formed, unlike the fabrication technique used with crystalline silicon solar cells in which multiple solar cells are severed and connected, it is easy to create cells with a variety of voltages.

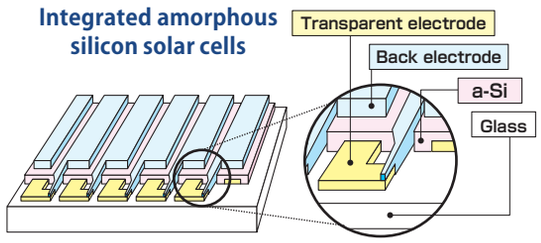
Crystalline silicon solar cells



Variety of shapes and forms

The methods used in amorphous silicon films have special features that allow other substrates, such as stainless steel or plastic films, to be used instead of customary glass substrates. This means that previously unknown solar cells can also be created, including solar cells that are round, square, or any other complex shape or solar cells that can even be bent. It is also possible to create areas in these solar cells that just consist of transparent glass by etching.

Integrated amorphous silicon solar cells



High sensitivity within visible light spectrum

The human eye is sensitive to light from a range of about 400 to 700 nm wavelengths. Since amorphous silicon solar cells are sensitive to light with essentially the same wavelengths, they can also be used as visible light sensors.

Location of use	Substrate	Features	References
Indoors	Glass	Representative substrate for such purposes as calculators	Page 7
	Stainless steel	Thin, lightweight, unbreakable, and easily formed into arbitrary shapes of highly precise dimensions	Contact us.
	Film	Thin, lightweight, unbreakable and easily formed into arbitrary shapes ※	Contact us.
Outdoors	Glass	Representative substrate For recharging secondary batteries outdoors, etc.	Page 7
	Stainless steel	Thin, lightweight, unbreakable, and easily formed into arbitrary shapes with highly precise dimensions	Contact us.
	Film	Thin, lightweight, unbreakable, and easily formed into arbitrary shapes ※	Page 8
Visible light sensor	Glass	Supports designs for arbitrary sizes and patterns as required for applications	Page 8

※ Material's flexibility is limited.

Amorton applications : examples of use

- Wristwatches / Clocks / Wall clocks
- Calculators
- Energy-harvesting equipment
- Wireless sensor networks / RFID tags / RF remote controls for digital home appliances, etc.
- Power sources for multiple cards attached to displays
- Power sources of wearable terminals
- Toys
- e-books
- Garden lights, sensor lights, LED blinkers (curbstone markers, etc.)
- Car accessories and battery chargers
- Security devices
- Power sources for other electric equipment and digital displays
- Reduction of battery replacements and extension of battery life for appliances using dry cells and coin batteries

*Please contact us about replacing selenium cells.

Categories of Light Sources

Amorton is available for use under a variety of light sources.

Natural light		Sunlight
Artificial light	Incandescent light	General use incandescent lighting, such as halogen lamps
	Fluorescent light	Daylight color, white, and mid-day color
	Electric discharge lamps	Mercury-vapor, sodium-vapor, and xenon lamps
	E L※	Light-emitting diodes (LED), organic ELs

※ EL : Electroluminescence

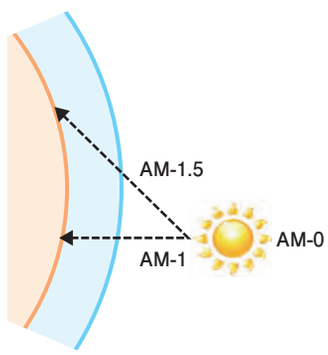
Concerning sunlight

Since the nature of sunlight varies by season and climate, the conditions for measuring the output of solar cells have been unified as a world standard.

<STC : Standard Test Conditions>

- Solar irradiance: 1000W/㎡ (=100mW/㎠)
- Spectrum: AM-1.5
- Cell temperature: 25℃(degrees Celsius)

AM (air mass) is used for the sunlight spectrum.
AM indicates the distance traveled by the sunlight through space: AM-0 in outer space, AM-1 when the sun is at the equator, and AM-1.5 in the latitudinal area of Japan.

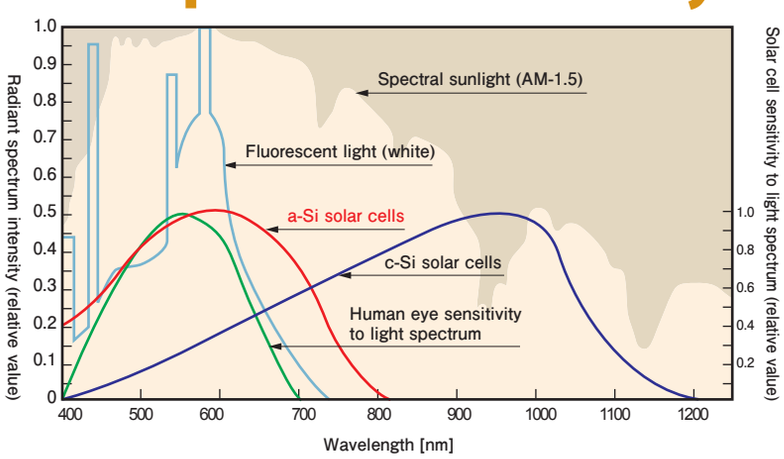


Illumination Levels as References

- **Brightness around Amorton is critical because it is used both indoors and outdoors.**
- **Unit of luminous intensity is lux (lx).**

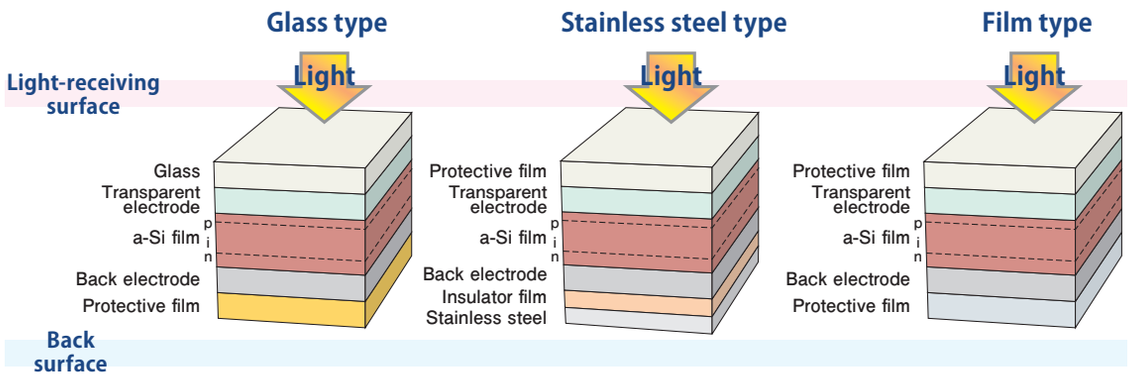
Fluorescent light		Sunlight	
Conditions	Illumination levels (lx)	Conditions	Illumination levels (lx)
Design stands (partially illuminated)	～1,000	Direct sunlight	100,000 ～ 120,000
Offices and conference rooms	300 ～ 600	Bright	10,000 ～ 100,000
Restaurants, coffee shops, dressing/changing rooms	75 ～ 150	Cloudy	10,000 ～ 50,000
Indoor emergency staircases	less than 75	Rainy	1,000 ～ 20,000

Radiant Spectrum of Light Source and Spectral Sensitivity of Solar Cells



Light wavelength differs depending on the light sources to which they are exposed. Spectral sensitivity of solar cells also differs depending on the category. Amorphous silicon solar cells provide light-sensing capability similar to the human eye.

Amorton Configuration



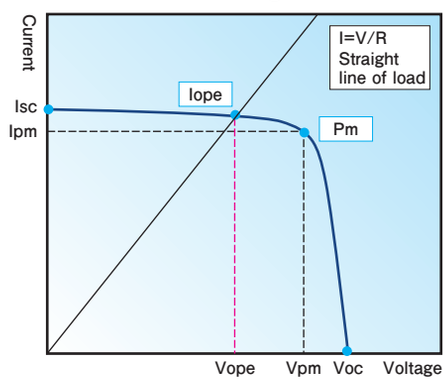
View of Electrical Properties of Amorton

The figure to the right shows Amorton's electrical Properties by current-voltage curves, which change depending on the incident light intensity and on the surrounding temperature of the solar cells.

Voc : open-circuit voltage
Isc : short-circuit current
Vpm : optimum power operating voltage
Ipm : optimum power operating current
Pm : maximum power =Vpm x Ipm
Vope : operating voltage (specified voltage)
Iope : operating current

※Current drastically changes under Vpm or higher.
For keeping the stable current under the anticipated illumination level, set the Vope as high as or lower than the Vpm.

Current-voltage curve

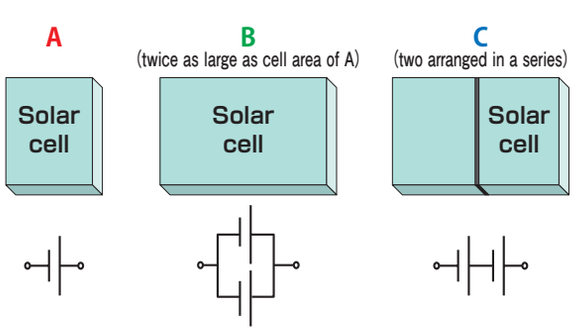


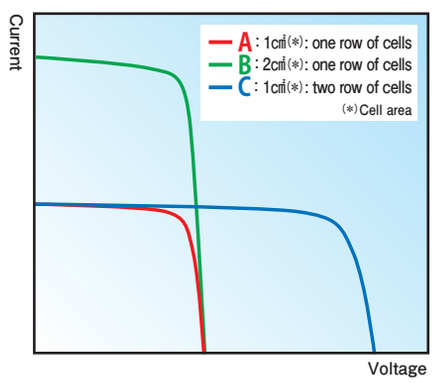
Relationship Between Number of Rows on Solar Cell /Cell Area and Electrical Properties

*Description based on A

	Conditions		Electrical property		
	Number of cell rows	Cell area	Voc ratio	Isc ratio	Pm ratio
A	1	1	1	1	1
B	1	2	1	2	2
C	2	1	2	1	2

The current generated by solar cells is proportional to their area. Therefore, when the cell area is doubled under a specified illumination level, the current is also doubled. When the number of cells is doubled, the voltage is doubled due to the circuit series. The electrical properties specific to relevant use are available by adjusting the number of solar cells and the cell area.





Amorton Electrical Properties

■Electrical Properties of Amorton for Indoor Use

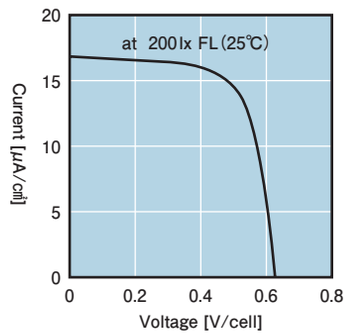
Substrate	Open-circuit voltage	Short-circuit current	Maximum power	Light source
Glass	0.63V/cell	17.0μA/cm²	7.3μW/cm²	FL-200lx
Film	0.69V/cell	17.0μA/cm²	9.0μW/cm²	FL-200lx

FL=fluorescent light

The illumination level of light sources used outdoors, such as fluorescent or incandescent light, ranges from 50 to 1,000 lux. Indoors, Amorton is most suitable for such small equipment as electronic calculators.

(Since Amorton is designed for outdoor use, please use it under 1,000 lux.)

Current-Voltage Characteristics of a Cell

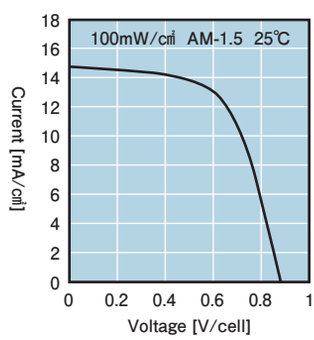


■Electrical Properties of Amorton for Outdoor Use (glass type)

Open-circuit voltage	Short-circuit current	Maximum power	Light source
0.89V/cell	14.8mA/cm²	7.89mW/cm²	AM1.5, 100mW/cm²

Generally, the illuminance of natural light ranges from 10,000 to 100,000 lux. Amorton is suitable for outdoor use, including such compact equipment as battery recharges.

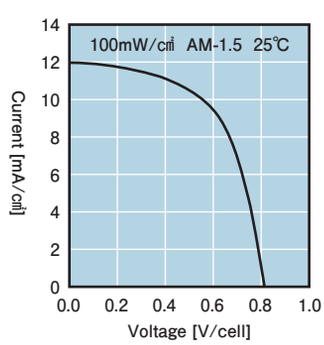
Current-Voltage Characteristics of a Cell



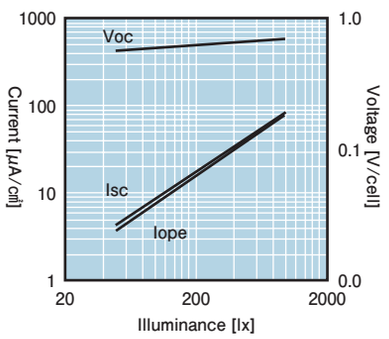
■Electrical Properties of Amorton for Outdoor Use (film type)

Open-circuit voltage	Short-circuit current	Maximum power	Light source
0.82V/cell	12.0mA/cm²	5.6mW/cm²	AM1.5, 100mW/cm²

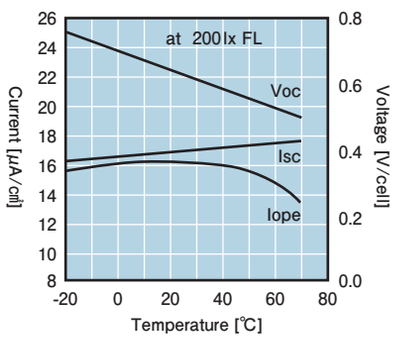
Current-Voltage Characteristics of a Cell



Relationship between Output and Illuminance

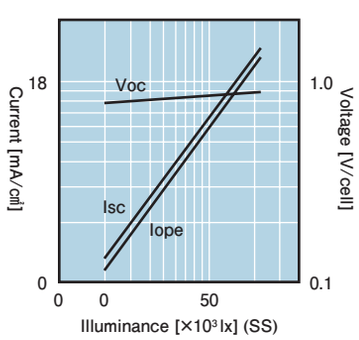


Relationship between Output and Temperature

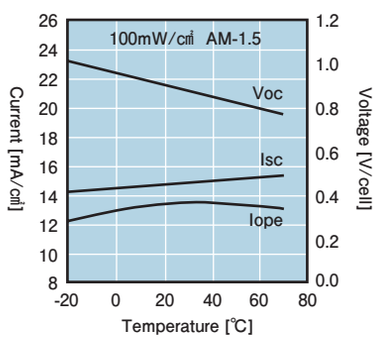


Temperature coefficient	
Voc	-0.45%／℃
Isc	0.08%／℃

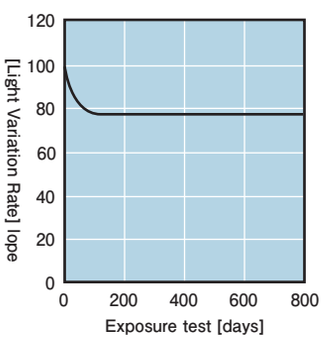
Relationship between Output and Illuminance



Relationship between Output and Temperature

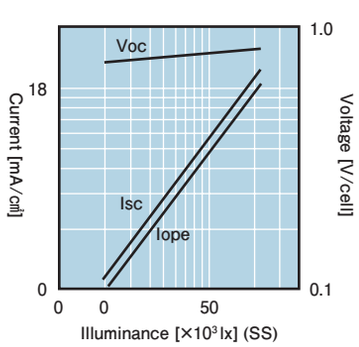


Lightproof [Outdoors]

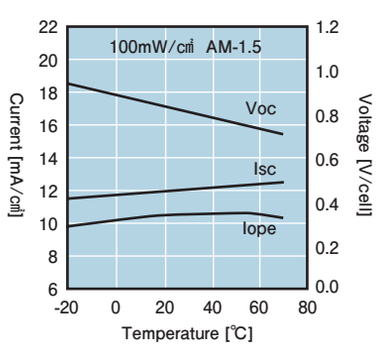


Temperature coefficient	
Voc	-0.3%／℃
Isc	0.08%／℃

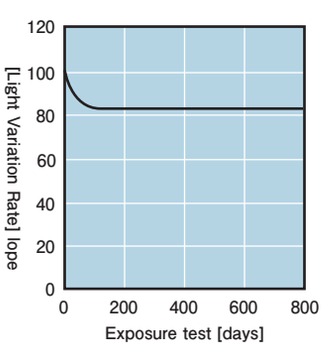
Relationship between Output and Illuminance



Relationship between Output and Temperature



Lightproof [Outdoors]



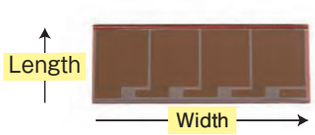
Temperature coefficient	
Voc	-0.3%／℃
Isc	0.08%／℃

Amorton Product List (made with a glass substrate)

■Indoor products

Customization available

The following are the standard products included in our lineup.
Designs may be customized based on requests. For inquiries, please refer to the back cover.



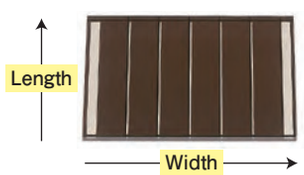
Model	Fluorescent light : 200lx (25℃)			External dimensions (mm)	Weight (g)
	Voc	Isc	Vope-Iope	Width x length x thickness	
AM-1312	1.8V	16.0μA	1.2V-14.5μA	38.0×12.5×1.1	1.3
AM-1456	2.4V	6.0μA	1.5V-5.3μA	25.0×10.0×1.1	0.7
AM-1411	2.4V	8.5μA	1.5V-8.0μA	29.6×11.8×1.1	1.0
AM-1437	2.4V	8.5μA	1.5V-8.0μA	29.6×11.8×1.1	1.0
AM-1407	2.4V	12.5μA	1.5V-11.5μA	38.0×12.5×1.1	1.3
AM-1417	2.4V	13.5μA	1.5V-12.5μA	35.0×13.9×1.1	1.3
AM-1424	2.4V	22.0μA	1.5V-20.0μA	53.0×13.8×1.1	2.0
AM-1454	2.4V	35.0μA	1.5V-31.0μA	41.6×26.3×1.1	3.0
AM-1513	3.0V	16.5μA	1.8V-15.0μA	55.0×13.5×1.1	2.0
AM-1522	3.2V	60.6μA	2.1V-56.9μA	55.0×40.5×1.1	6.3
AM-1606	3.6V	3.5μA	2.6V-3.1μA	15.0×15.0×0.7	0.4
AM-1713	4.3V	16.3μA	3.0V-15.2μA	96.6×10.0×1.1	2.7
AM-1719	4.2V	18.2μA	3.0V-16.6μA	41.6×26.3×1.1	3.1
AM-1819	4.9V	7.5μA	3.0V-6.9μA	31.0×24.0×1.1	2.2
AM-1820	4.9V	14.5μA	3.0V-13.3μA	43.0×26.0×1.1	3.1
AM-1805	4.9V	16.5μA	3.0V-15.5μA	55.0×20.0×1.1	3.0
AM-1801	4.9V	20.0μA	3.0V-18.5μA	53.0×25.0×1.1	3.6
AM-1815	4.9V	47.0μA	3.0V-42.0μA	58.1×48.6×1.1	7.8
AM-1816	4.9V	94.0μA	3.0V-84.0μA	96.7×56.7×1.1	15.6

※The above patterns are representative operating patterns (initial/default values).

■Outdoor products

Customization available

The following are the standard products included in our lineup.
Designs may be customized based on requests. For inquiries, please refer to the back cover.



Model	100mW/cm² AM-1.5 (25℃)		SS-50klx (25℃)		External dimensions (mm)	Weight (g)
	Vope-Iope	Pm (Vpm-Ipm)	Vope-Iope	Pm (Vpm-Ipm)	Width x length x thickness	
AM-5308	1.7V-68.8mA	117mW (1.9V-61.5mA)	1.7V-31.1mA	58mW (1.9V-29.2mA)	50.1×47.2×1.1	6.4
AM-5302	1.7V-105.0mA	181mW (1.9V-95.5mA)	1.7V-47.0mA	86mW (1.9V-45.1mA)	31.2×117.8×1.8	16.3
AM-5413	2.2V-16.7mA	39mW (2.6V-15.0mA)	2.2V-7.5mA	18mW (2.6V-7.1mA)	33.0×23.9×1.1	2.1
AM-5412	2.2V-39.8mA	93mW (2.6V-35.8mA)	2.2V-17.9mA	44mW (2.6V-16.9mA)	50.1×33.1×1.8	7.3
AM-5610	3.3V-5.1mA	18mW (3.9V-4.6mA)	3.3V-2.3mA	8mW (3.9V-2.2mA)	25.0×20.0×1.8	2.2
AM-5613	3.3V-31.6mA	110mW (3.9V-28.2mA)	3.3V-14.5mA	52mW (3.9V-13.3mA)	60.1×36.7×1.8	9.8
AM-5608	3.3V-36.0mA	125mW (3.9V-32.0mA)	3.3V-16.5mA	59mW (3.9V-15.1mA)	60.1×41.3×1.8	11.0
AM-5605	3.3V-115.4mA	401mW (3.9V-102.7mA)	3.3V-52.9mA	189mA (3.9V-48.6mA)	62.3×117.8×1.8	32.5
AM-8706	3.9V-19.9mA	81mW (4.6V-17.7mA)	3.9V-9.0mA	39mW (4.6V-8.3mA)	36.1×41.3×1.1	4.1
AM-8704	3.9V-23.8mA	97mW (4.6V-21.0mA)	3.9V-10.7mA	46mW (4.6V-9.9mA)	41.2×41.3×1.1	4.6
AM-8703	3.9V-32.1mA	131mW (4.6V-28.5mA)	3.9V-14.5mA	62mW (4.6V-13.4mA)	41.2×55.1×1.1	6.2
AM-5710	3.9V-32.6mA	134mW (4.6V-29.0mA)	3.9V-14.7mA	63mW (4.6V-13.7mA)	62.3×37.0×1.1	6.3
AM-8702	3.9V-34.4mA	140mW (4.6V-30.5mA)	3.9V-15.5mA	67mW (4.6V-14.4mA)	57.7×41.3×1.1	6.5
AM-5706	3.9V-45.9mA	186mW (4.6V-40.5mA)	3.9V-21.0mA	88mW (4.6V-19.1mA)	70.0×50.0×1.8	15.5
AM-8701	3.9V-46.6mA	190mW (4.6V-41.2mA)	3.9V-21.0mA	90mW (4.6V-19.4mA)	57.7×55.1×1.1	8.6
AM-5815	4.5V-2.5mA	12mW (5.2V-2.3mA)	4.5V-1.1mA	6mW (5.2V-1.1mA)	31.2×10.8×1.1	0.9
AM-5816	4.5V-6.5mA	32mW (5.2V-6.2mA)	4.5V-3.0mA	15mW (5.2V-2.9mA)	32.1×23.6×1.1	2.2
AM-5812	4.5V-19.8mA	93mW (5.2V-17.8mA)	4.5V-8.9mA	44mW (5.2V-8.4mA)	59.0×28.7×1.1	4.6
AM-5813	4.5V-25.0mA	117mW (5.2V-22.6mA)	4.5V-11.3mA	55mW (5.2V-10.7mA)	41.2×60.2×1.1	6.7
AM-8804	4.5V-33.3mA	156mW (5.2V-30.0mA)	4.5V-15.1mA	74mW (5.2V-14.2mA)	48.1×55.1×1.1	7.2
AM-5814	4.5V-38.6mA	180mW (5.2V-34.7mA)	4.5V-17.4mA	85mW (5.2V-16.4mA)	55.1×60.1×1.1	9.0
AM-8801	4.5V-41.9mA	196mW (5.2V-37.7mA)	4.5V-18.9mA	93mW (5.2V-17.8mA)	57.7×55.1×1.1	8.6
AM-5904	5.0V-9.9mA	52mW (5.9V-8.7mA)	5.0V-4.5mA	24mW (5.9V-4.1mA)	40.1×33.1×1.8	5.9
AM-5912	5.0V-15.3mA	80mW (5.9V-13.6mA)	5.0V-7.0mA	38mW (5.9V-6.4mA)	42.9×47.2×1.1	5.6
AM-5909	5.0V-22.2mA	116mW (5.9V-19.6mA)	5.0V-10.1mA	55mW (5.9V-9.3mA)	60.1×41.3×1.8	11.0
AM-5914	5.0V-23.1mA	121mW (5.9V-20.4mA)	5.0V-10.6mA	57mW (5.9V-9.7mA)	50.1×55.1×1.1	7.5
AM-5913	5.0V-30.1mA	157mW (5.9V-26.6mA)	5.0V-13.8mA	74mW (5.9V-12.6mA)	60.1×55.1×1.8	14.7
AM-5907	5.0V-45.7mA	241mW (5.9V-40.8mA)	5.0V-20.6mA	114mW (5.9V-19.3mA)	75.0×55.0×1.8	18.3
AM-5902	5.0V-60.8mA	317mW (5.9V-53.7mA)	5.0V-27.8mA	150mW (5.9V-25.4mA)	150.0×37.5×1.8	25.0
AM-7A03	5.5V-227.0mA	1336mW (6.6V-202.3mA)	5.5V-113.0mA	702mW (6.6V-106.3mA)	150.0×165.0×1.8	110.0
AM-7D08	7.2V-172.0mA	1303mW (8.5V-153.2mA)	7.2V-85.0mA	684mW (8.5V-80.5mA)	150.0×165.0×1.8	110.0
AM-5E02	7.7V-23.2mA	189mW (9.2V-20.5mA)	7.7V-10.6mA	89mW (9.2V-9.7mA)	75.0×55.0×1.8	18.3
AM-7E04	7.7V-104.0mA	852mW (9.2V-92.6mA)	7.7V-50.0mA	447mW (9.2V-48.6mA)	150.0×110.0×1.8	74.0
AM-5S06	15.4V-11.4mA	188mW (18.4V-10.2mA)	15.4V-5.1mA	89mW (18.4V-4.8mA)	124.5×29.5×1.1	10.0
AM-7S03	15.4V-70.0mA	1133mW (18.4V-61.6mA)	15.4V-34.5mA	595mW (18.4V-32.4mA)	150.0×165.0×1.8	110.0

Note : The above table shows standard weights, excluding lead.

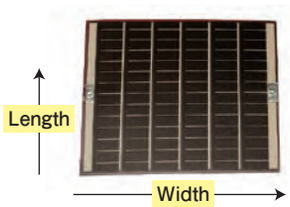
※The above patterns are representative operating patterns (initial/default values). ※SS : solar simulator

Amorton Product List (made with a film substrate)

■Outdoor products

Customization available

The following are the standard products included in our lineup.
Designs may be customized based on requests. For inquiries, please refer to the back cover.



Model	100mW/cm² AM-1.5 (25℃)		SS-50klx		External dimensions (mm)	Weight (g)
	Vope-Iope	Pm (Vpm-Ipm)	Vope-Iope	Pm (Vpm-Ipm)	Width x length x thickness	
AT-7665	3.0V-38.6mA	125mW (3.6V-34.7mA)	3.0V-17.3mA	58mW (3.6V-16.2mA)	58.4×56.0×0.3	2.0
AT-7664	3.0V-104.0mA	335mW (3.6V-93.0mA)	3.0V-46.5mA	156mW (3.6V-43.3mA)	73.0×112.0×0.3	4.0
AT-7666	3.0V-343.0mA	1109mW (3.6V-308.2mA)	3.0V-154.0mA	517mW (3.6V-143.6mA)	146.0×167.5×0.3	13.0
AT-7705	3.5V-33.3mA	128mW (4.2V-30.5mA)	3.5V-16.2mA	62mW (4.2V-14.7mA)	73.0×42.0×0.3	4.0
AT-7802	4.0V-29.7mA	127mW (4.8V-26.4mA)	4.0V-14.3mA	62mW (4.8V-12.9mA)	73.0×42.0×0.3	4.0
AT-7963	4.5V-223.0mA	1083mW (5.4V-200.6mA)	4.5V-100.0mA	505mW (5.4V-93.5mA)	146.0×167.5×0.3	13.0
AT-7S63	15.0V-134.0mA	2104mW (16.8V-125.2mA)	15.0V-60.5mA	980mW (16.8V-58.3mA)	292.0×168.0×0.3	25.0
AT-7S64	15.0V-269.0mA	4208mW (16.8V-250.4mA)	15.0V-121.0mA	1960mW (16.8V-116.7mA)	292.0×336.0×0.3	50.0

Note : The above table shows standard weights, excluding lead.

※The above patterns are representative operating patterns (initial/default values). ※SS : solar simulator

Amorton Product List (watches)

Customization available

The following are the standard products included in our lineup.
Designs may be customized based on requests. For inquiries, please refer to the back cover.

Model	Substrate	Vope-Iope Fluorescent light : 200lx (25℃)	External dimensions (mm) Width x length x thickness	Weight (g)
AL-2402	Stainless steel	1.5V-10.1μA	φ27.2×0.2	0.7
AT-2400B	Film	1.5V-18.5μA	26.3×26.8×0.18	0.1
AT-2600B	Film	2.6V-11.6μA	26.3×26.8×0.18	0.1
AM-2709B	Glass	3.0V-3.3μA	φ30.8×0.7	1.3

※The above patterns are representative operating patterns (initial/default values).


AL-2402


AT-2400B


AT-2600B


AM-2709B

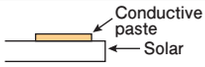
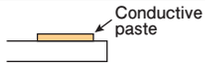
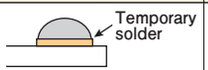
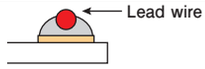
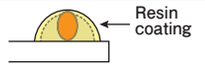
Amorton Product List (photosensors)

The following are the standard products included in our lineup.
Designs may be customized based on requests. For inquiries, please refer to the back cover.

Model	Terminal configuration	Element number	Short-circuit current TYP	Dark current (VR=50mV) MAX	External dimensions (mm) Width x Length x Thickness
AM-30-11	C,CS,CA	1	17.7μA ※1	—	14.0×13.0×1.1
AM-30-28	CS	1	7.5μA ※2	10pA	5.0×3.0×0.7
AM-30-31	C	1	1.2μA ※2	10pA	2.1×2.0×0.4

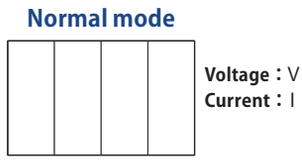
※1 200 lx, (fluorescent light)
※2 1,000 lx (fluorescent light for color illuminators)

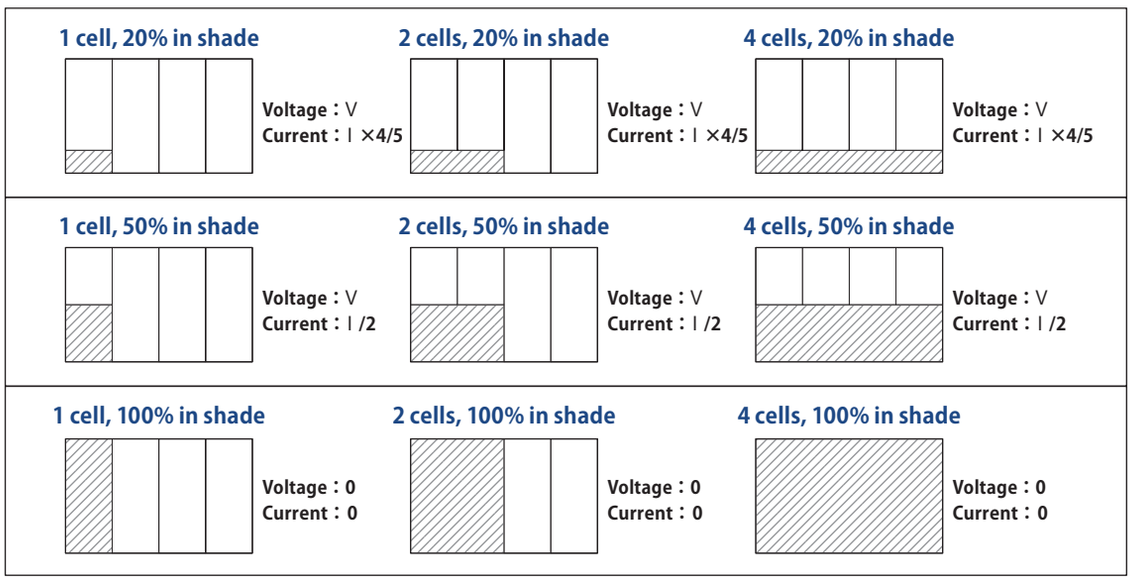
Terminal Structures

Indoors				Outdoors
B type	C type	CS type	CA type	CAR type, A type
				
Cannot be soldered. A heat seal may be used.	Lead wire can be attached using a regular solder.	A temporary solder is attached to a C type device.	A C type terminal with a lead wire	Pins are protected with a resin coating after lead is attached.
●Mainly for watches	●Primarily for indoor products ●Outdoor products ●Photosensors	●Mainly photosensors	●Mainly for indoor products ●Photosensors	●Primarily for outdoor products ※CAR type (glass) ※A type (film)

Effects on Output in Shaded Areas

Amorton is an integrated structure connected with series of solar cells. Since its generated current is proportional to the area of the solar cells exposed to sunlight, the generated output changes in partial shade.





※These are basic examples. The influence depends on the depth of the shade.

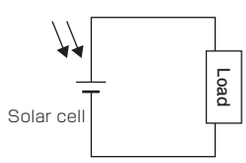
Circuit Reference Examples

Specified usage examples

①Direct connection type

Application

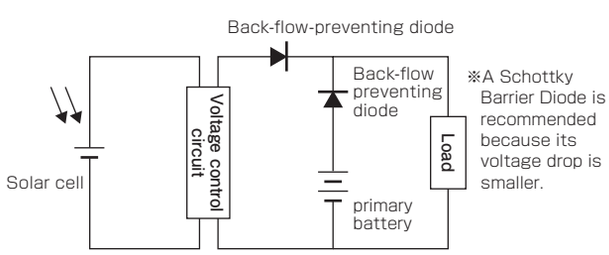
Toys, DC motors, etc.



②Combination-type primary battery

Application

Clocks (both wall and table clocks),
thermometer/hygrometers,
remote controls, calculators, etc.

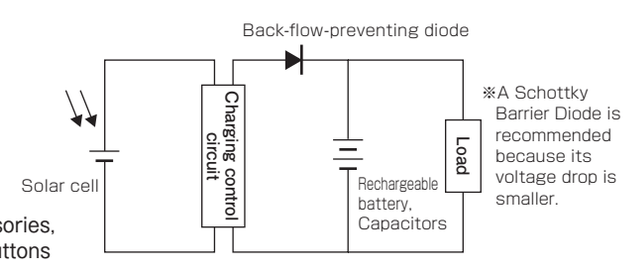


※A Schottky Barrier Diode is recommended because its voltage drop is smaller.

③Rechargeable battery

Application

Watches (wristwatches),
clocks (both wall and table clocks),
garden lights, PC peripheral devices,
mobile chargers, battery chargers,
short-range communication terminals, car accessories,
LED lighting devices, flickering devices, traffic buttons



※A Schottky Barrier Diode is recommended because its voltage drop is smaller.

Inquiry Sheet

By providing the following information, we can respond to your inquiries more smoothly. Please contact us at the information found on the back cover.

■In the case of general purpose products

Application (Please provide the following information)	
Model	
Usage environment (indoors or outdoors)	
Types of rechargeable battery	
Terminal connection method	
Experience of using solar cell (Yes or No)	
Other requests	

■In the case of customized products

Application (Please provide the following information)	
Usage environment (indoors or outdoors)	
External dimensions (installation space)	
Required voltage	
Required current	
Types of rechargeable battery	
Terminal connection method	
Experience of using solar cell (Yes or No)	
Other requests	

Amorton

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Handling Precautions

■Handling Amorphous Silicon Solar Cells and Amorphous Photosensors

★Use care around broken glass to avoid injury.
★Avoid touching solar cells during the daytime because they get very hot when the sunlight is strong.
★If the light-receiving side is stained/smudged, the electrical output will decline due to a decrease in the incident light. Carefully clean the sides to remove stains.
★Pressing or scratching the energy-generating area with a hard object may decrease the output.
★These products are not water-resistant, or water-repellent, or shock-resistant. When using them outdoors, avoid getting them wet by placing them in an airtight container, when appropriate.
★When using your product, consider a fail-safe or redundant design.
★Consider a proper method for static electricity removal. Static electricity may damage the power generation element and decrease the output.
★Do not apply an indoor Amorton to a product that requires an outdoor environment. levels of light may not be obtained under high illumination.
★Do not apply an outdoor Amorton to a product that requires an indoor environment. The necessary output may not be obtained under low light levels.
★Please test your products for anomalies and circumstances that cannot be predicted by evaluating a single Amorton.

■Storage

★Store in a cool (under a specific temperature range of -20℃~70℃), low-humidity environment free of corrosive gas to avoid such problems as electrode corrosion to the solar cells.

Points to Consider in Adopting Our Products

●Any and all of our products described or contained herein are, with regard to standard application, intended for use as general electronics equipment, including home appliances, AV equipment, communication devices, office equipment, industrial equipment, etc.
The products mentioned herein are not intended for any special applications (such as life-sustaining medical equipment, aerospace instruments, nuclear control devices, appliances for burning, transportation machines, traffic signal systems, safety equipment, etc.) that require extremely high levels of reliability and can directly threaten human lives during product failure or malfunction that might threaten lives; no guarantees thereof shall be granted. If you intend to use our products for applications outside the standard applications and/or outside the scope of the intended standard applications, please consult us prior to such use. Without such consultation or inquiry, the customer shall be held solely responsible.

●Specifications of any or all of our products described or contained herein stipulate the performance, characteristics, and functions of the described products in their independent state and are not guarantees of performance, characteristics, and functions as mounted in the customer's products or equipment. To verify the symptoms and states that cannot be evaluated in independent devices, the customer should always evaluate and test devices mounted in its products or equipment.

●Our company assumes no responsibility for equipment failures that result from using products at values that exceed (even momentarily) the rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in the products specifications of any and all of our products described or contained herein.

●Our company supplies high-quality high-reliability products; however, any and all semiconductor products may fail or malfunction. Such probabilistic failures or malfunctions might cause accidents or incidents that could endanger lives, problems that might produce smoke or fire, or accidents that might damage property.
At the time of the equipment design, adopt safety measures to avoid such accidents or events. Such measurements include but are not limited to protective circuits and error prevention circuits for safe, redundant, and structural designs.

●In the event that any or all our products described or contained herein correspond to restricted freight regulations stipulated in the Foreign Exchange and Foreign Trade Act, such products may require an export license from the concerned authorities in accordance with the above law.

●Any and all information described or contained herein is subject to change without notice due to product/technology improvements, etc. When using equipment, refer to the Delivery Specifications for the product that you intend to use.

●Information (including circuit diagrams and circuit parameters) herein are only examples; the volume of production is not guaranteed.

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